Notes on the Poppy tone test cylinder CYC5001a

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When a recorded cylinder is played on a traditional stylus system, such as the Archeophone, the maximum frequency which can be reproduced is limited by the physical dimensions of the stylus. This is the well known "tracing error" which was recognized as far back as the 1930's or earlier by Edison.

This maximum is lower than the maximum frequency which can be recorded since the cutting stylus is sharper than the playback stylus.

The tracing error leads to both signal attenuation and harmonic distortion since the signal becomes asymmetric – ie the stylus can read the high points but not the low points.

The practical limitations in traditional stylus playback occur around a few KHz.

The IRENE system (Figure 1) uses a 3D optical probe to image the entire cylinder surface. The resolution is such that the surface can be sampled at a rate equivalent to 100 KHz (50 KHz Nyquist limit) without tracing error. This means the IRENE system results in a FLAT transfer with a cutoff around 50 KHz maximum frequency. With this sort of resolution we can see structures which are not visible with a practical stylus.

In the case of CYC5001a

- We see a tone at 5.5 KHz with a clear overtone at 11 KHz (Figure 2)
- In the case of the sweep, we can see the tone up to 18 KHz (Figure 3)
- There is a broad and prominent feature at 24.9 KHz – this is a texture visible wherever the surface has been cut and is likely due to high frequency "tool chatter" in the cutter. We have seen this feature on others, but not all cylinders.

Note the reason that high frequency has generally higher amplitude is due to the constant velocity condition.

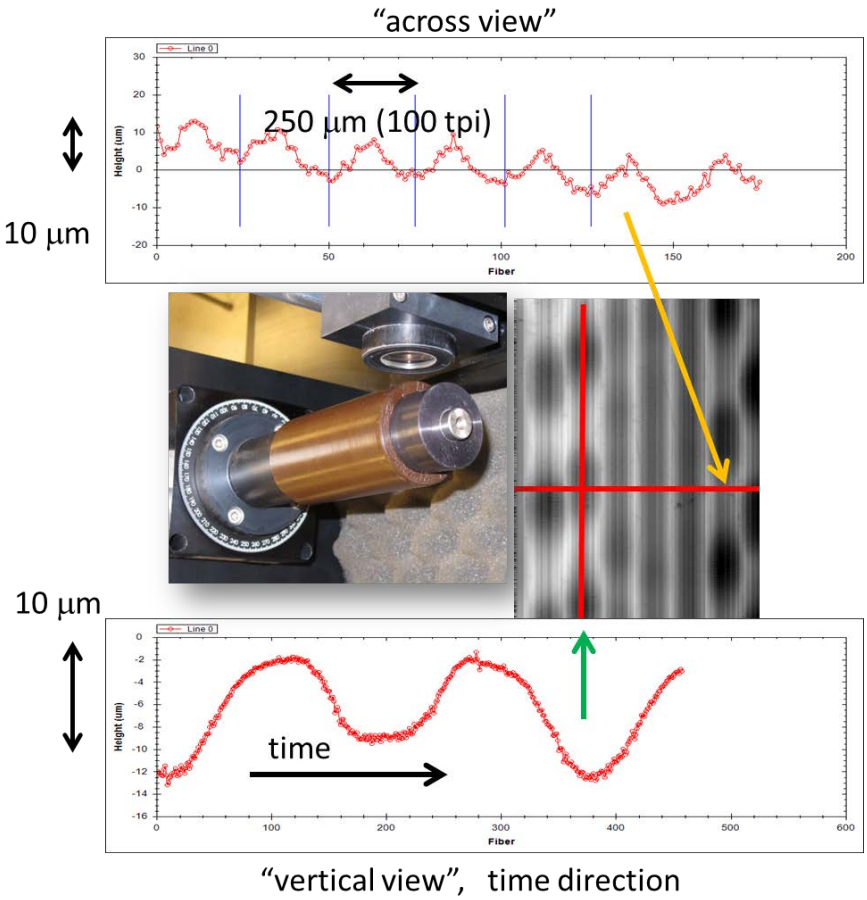

Figure 1: Explanation of IRENE sytem. The cylinder shown at middle left is on the scanner. Time is the direction around the circumference. The groove runs as a helix around the cylinder from one end to the other. The probe measures depth. The image at middle right is a small clip from a full measurement. In this image, darker is deeper. The vertical red line is along the time direction and corresponds to the linear travel of the stylus. A vertical profile, the "vertical view" is shown in the lower trace. While time progresses the stylus moves vertically in this view, here by about 10 microns. At top is shown the "across" view which is therefore a cross section across the groove, and runs parallel to the axis of the cylinder. The vetical blue lines are where the analysis has determined the centers of each pass are located. Each blue line, and the points around it would be a time difference of one revolution from those displaced left or right by one groove spacing.

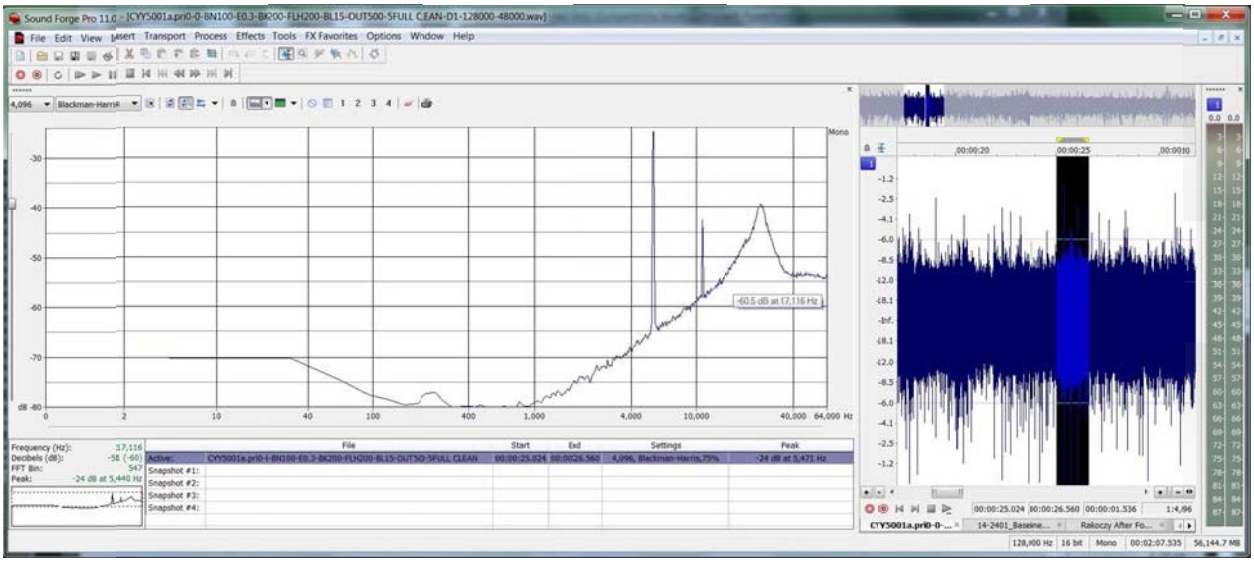

Figure 2: Frequency spectrum of data from IRENE on CYC5001a showing tone, overtone, and broad peak at 24.9 KHz due to tool vibration (?).

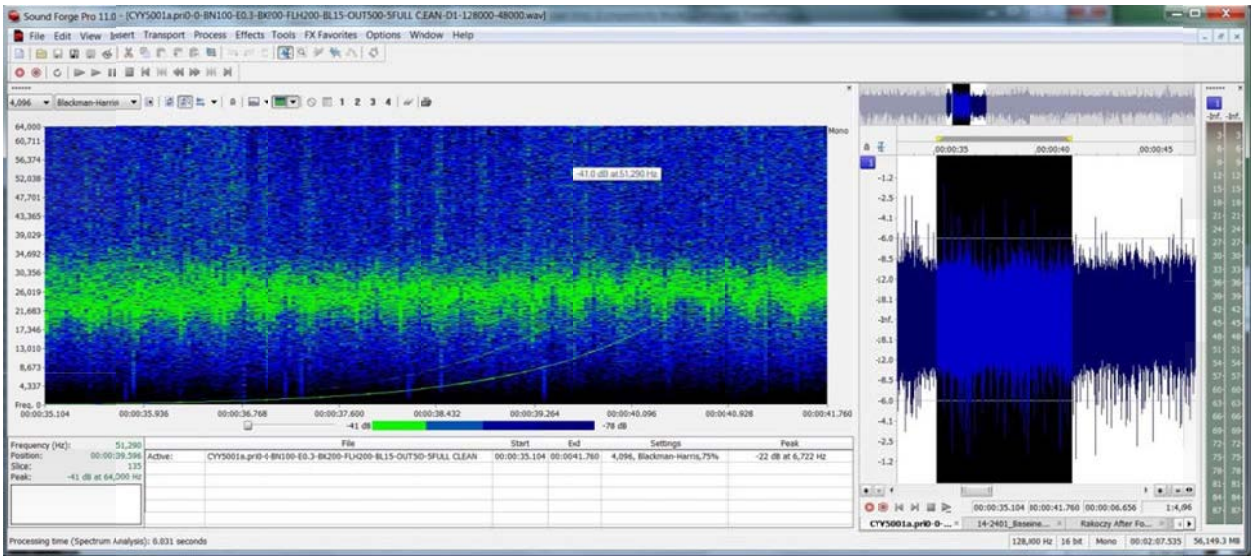

Figure 3: Spectrogram of frequency sweep. Broad feature is the tool vibration is persists everywhere.,

Note swept tone and over tone up to at least 18 KHz,